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Description

Organic electronic component comprising a patterned, semiconducting functional layer and a method for producing said component

The invention relates to an organic electronic component such as an organic field effect transistor and a method for producing said component, the semiconducting layer of the component being patterned.

In the case of organic electronic components, the organic semiconducting functional layers are usually applied in large-area fashion by spin-coating, spraying on, squeegeeing or the like as homogeneous large-area but very thin functional layers.

In an integrated circuit, that may lead to problems since leakage currents arise from one component or from one electrode to the next if the semiconducting functional layers of the components adjoin one another. Said leakage currents disrupt the performance of the circuit in some instances, considerably. Therefore, attempts are made to pattern the semiconducting functional layers and/or to reduce them to the active areas, that is to say the regions where current channels form. This patterning can be achieved by means of corresponding exposure masks in the case of components produced photolithographically. Components produced photolithographically become too expensive, however, for broad application. Therefore, the focus is on inexpensive printing production methods for the development of the elements.

However, the semiconducting functional layer cannot be applied in patterned fashion by conventional printing methods because this layer must be very thin (typically less than 100 nm) in order for it to function. The

layer thicknesses required for the semiconducting functional layer, for example, can conventionally be achieved only by means of a coating process such as coating, spraying on, etc.

It is an object of the present invention to make it possible, in the case of organic electronic components produced in printed fashion, to pattern a thin, in particular the semiconducting functional layer without in this case increasing the layer thickness of the affected functional layer in comparison with a, e.g. semiconducting, functional layer normally produced by a coating process (coating, spraying on, squeegeeing).

The invention relates to an organic electronic component comprising a patterned semiconducting functional layer having a thickness of less than 100 nm, the patterning arising by virtue of a lower functional layer being only partially wetted with the organic functional material of the next functional layer. The invention additionally relates to a method for producing an organic electronic component, in which, through targeted treatment of a lower functional layer, an upper functional layer is produced in patterned fashion despite large-area application.

According to one embodiment of the method, a semiconducting layer is produced in patterned fashion.

According to one exemplary embodiment, the lower functional layer is partially covered by a resist that can be applied with a very small layer thickness by printing.

Semiconducting, insulating, and/or conductive organic functional layers, but of course also inorganic functional layers, such as e.g. thin metal layers, can be produced in patterned fashion by the method as upper, patterned functional layers.

Depending on the construction of the organic electronic component and the upper layer, the lower functional layer is the substrate, a conductive functional layer, etc.

The term "targeted treatment" denotes the partial coverage and/or the local alteration of the lower functional layer, which has the effect that, in selected regions of the lower functional layer, in the course of coating with the material, wetting takes place or is avoided (that is to say "partial wetting" takes place), and can be effected by means of a printing method, by laser treatment, thermal treatment, other physical, electrical or chemical treatment, but always partially and with a resolution in the µm range. By way of example, mention shall be made of partial contact-making with acid/base or other reactive chemical substances, physical effects such as light, heat, cold, and finally mechanical treatment such as rubbing. The treatment has the consequence in any event that the next functional layer does not undergo wetting on the treated locations or undergoes wetting only there.

The term "organic material" and/or "functional polymer" here encompasses all types of organic, organometallic and/or inorganic plastics. It concerns all types of substances with the exception of the semiconductors that form the traditional diodes (germanium, silicon) and the typical metallic conductors. Accordingly, a restriction in the dogmatic sense to organic material as material containing carbon is not envisaged, rather the broad use of e.g. silicones is also conceived of. Furthermore, the term is not intended to be subject to any restriction with regard to the molecular size, in particular to polymeric and/or oligomeric materials, rather the use of "small molecules" is also entirely possible.

The invention will be explained below with reference to two figures showing a plan view and a cross section through an exemplary embodiment of an organic electronic component according to the invention:

Figure 1 shows a plan view of a circuit having a patterned semiconducting functional layer. An organic circuit constructed on a substrate (concealed) can be seen. A plurality of active elements such as organic field effect transistors are arranged one beside the other; the source/drain electrodes 2 can be discerned in each case. The hatched region shows the organic semiconductor layer 1, which is patterned and has partial regions 3 which are free of semiconducting functional material. The free region 3 ("free" in this case means covered neither with conductive nor with semiconducting material) suppresses a leakage current from the left-hand region into the right-hand region of the circuit.

Figure 2 shows an OFET having the substrate 4 and the source/drain electrodes 2. Situated on the conductive functional layer, the source/drain electrodes 2, is the patterned semiconducting functional layer 1, which does not extend over the conductive functional layer 2 in whole-area fashion, but rather is interrupted by the resist 6, which partially covers the substrate 4 against wetting with semiconducting functional layer 1, in other words said semiconducting functional layer covers in patterned fashion only the active areas, that is to say the areas above the source/drain electrodes. The semiconducting functional layer for its part is covered by the insulating functional layer 5, on which the gate electrodes 7 are situated.

The invention relates to an organic electronic component such as an organic field effect transistor and a method for producing said component, a thin

layer, such as the semiconducting layer of the component being patterned, although the component can be produced by an inexpensive printing method. In order to achieve this, the lower functional layer is prepared by a treatment such that it has partial regions on which wetting takes place in the subsequent process step, and partial regions on which wetting is not effected.